TECHNICAL MEMORANDUM NO. 2

February 10, 2015

To	Town of Eastham		
Copy to	Jane Crowley		
From	Jessica Janney	Tel	774-470-1636
	Anastasia Rudenko, P.E., ENV SP		774-470-1637
	J. Jefferson Gregg, P.E., BCEE		774-470-1640
Subject	Eastham Wastewater Management Plan Update to Wastewater and Nitrogen Management Alternatives Screening Analysis	Job No.	8618665

1. INTRODUCTION AND SCOPE

The Town of Eastham has been developing a Wastewater Management Plan since 2007 and completed its Interim Needs Assessment Report (NAR) and Alternatives Screening Analysis (ASAR) Report in March 2009; and Wastewater Management Planning Project Plan Evaluation Report in June 2009. As a result of these efforts, the Town's wastewater plan in 2009 included the following recommendations:

1. Development of a public water supply system that draws water from a protected source to address septic-system wastewater impacts on individual private water supplies.
2. Development of a Ponds Action Plan and remediation of the Town's ponds that are most impacted from eutrophication (excessive algal growth) caused by excessive phosphorus loading to the ponds from several sources including wastewater.
3. Development of a wastewater collection system to collect wastewater from the Nauset-Town Cove Estuary, and Rock Harbor watersheds for treatment and discharge at the Tri-Town Septage Treatment Plant site in association with the Orleans wastewater management plan.

This planning effort was completed before nitrogen limits were fully developed for the Nauset Estuary (including Town Cove and Salt Pond) and Rock Harbor. The original approach of the recommendations was also based on the Orleans planning efforts and discussion of a regional solution at the Tri-Town facility site.

The purpose of this Technical Memorandum is to provide an update to the Alternatives Screening Analysis in order to guide the Town decision-making in developing a revised/updated wastewater management plan; to take into consideration additional information developed as part of the Cape Cod Commission (CCC) 208 Planning process; and changes in the Town of Orleans planning approach to addressing their nitrogen loading to Town Cove and Rock Harbor.

GHD Inc. 1545 Iyannough Road Hyannis MA 02601 USA
T 1 774 470 1630 **F** 1 774 470 1631 **E** hyamail@ghd.com **W** www.ghd.com

This Technical Memorandum No. 2 follows a similar format to Technical Memorandum No. 1, which provided an update of the 2009 Interim Needs Assessment. The memorandum will summarize the following:

- Reconsideration of Alternatives screened in March 2009 Final Interim (Needs Assessment) & Alternatives Screening Analysis Report and the recommendations made as part of the 2009 Plan Evaluation Report.
- Additional nitrogen management concepts developed in the CCC 208 plan.
- Background (book-end evaluations developed in the 208 planning project).
- Summary of feasible alternatives and proposed evaluation process for the Project Focus Area.
- Outline of the process of evaluating hybrid solutions for Salt Pond and Town Cove.

2. BACKGROUND

2.1. Previous Findings of Eastham's Wastewater Planning Project Related to Coastal Estuaries and Nitrogen Mitigation

The Alternatives Screening Analysis Report, which was completed in 2009, evaluated available technologies and management concepts, and recommended a short list of alternative management plans for further evaluation. These plans were identified for each of the target areas presented in 2009: Rock Harbor, Nauset Estuary/Town Cove, and the Freshwater Ponds as shown in Figure 1. The dark blue hatched area represents the estimated watersheds to the freshwater ponds.

Each of the plans are summarized below (not including those related to recommendations for a Town-wide water system to protect public health and the freshwater pond treatments, both of which have undergone some level of implementation in Town):

A. Alternative Wastewater Management Plans for the Rock Harbor Watershed:

1. Rock Harbor Watershed Plan 1. This plan included the following components:
   - Sewer extension to the properties in the watershed, the extent of which is displayed in Figure 2.
   - Construction of a new community/municipal wastewater treatment facility at the Roach Property site in Northern Eastham. The property is outlined in red in Figure 2.

   This alternative was contingent on the availability of an acceptable treatment and recharge site and could be part of a long-term management and remediation plan for Rock Harbor.
2. Rock Harbor Watershed Plan 2 **(Recommended as part of the 2009 planning efforts)**. This plan included the following components:
   - Sewer extension to the properties in the watershed, the extent of which is displayed in Figure 2.
   - Connection of this sewer system to the Orleans Wastewater Treatment Facility (WWTF) proposed to be constructed at the Tri-Town Facility site.

This alternative plan was contingent on available capacity at the proposed Orleans WWTF and an inter-municipal agreement between the two towns.

3. Rock Harbor Watershed Plan 3. **(Recommended as part of the 2009 planning efforts)**. This plan would be further evaluation of ideas introduced by Brian Howes of MEP for possible aeration and dredging management of Rock Harbor. This type of management may be possible for Rock Harbor because it is not a natural estuary; it is a tidal creek that is continually dredged to maintain a boat basin. The feasibility of this plan is unknown and would require additional evaluation, possibly as a MassDEP pilot study.

Plan 2 and Plan 3 were both recommended in the 2009 Plan Evaluation Report. Plan 3 is the preferred alternative but needs to be discussed with MassDEP to determine if a lower nitrogen limit is warranted (due to Rock Harbor being a dredged boat basin) and if the limit could be met through alternative dredging or aeration methods. If Plan 3 cannot be implemented, Plan 2 becomes the recommended alternative management plan for this estuary.

B. Alternative Wastewater Management Plans for the Nauset-Town Cove Watershed:

1. Nauset-Town Cove Estuary Watershed Plan 1. This plan included the following components:
   - Sewer extension to the properties in the watershed, the extent of which is displayed in Figure 2.
   - Construction of a new community/municipal wastewater treatment facility at the Roach Property site in Northern Eastham. Outlined in red in Figure 2.
2. Nauset-Town Cove Estuary Watershed Plan 2. **(Recommended as part of the 2009 planning efforts)**. This plan included the following components:
   - Sewer extension to the properties in the watershed, the extent of which is displayed in Figure 2.
   - Connection of this sewer system to the Orleans Wastewater Treatment Facility proposed to be constructed at the Tri-Town Facility site.
3. Nauset-Town Cove Estuary Watershed Plan 3. This plan included the following components:
   - Individual on-site systems approved by MassDEP for nitrogen removal supported by an expanded Town Health Department to enforce operation, maintenance, and discharge compliance which would be completed by the property owner.

C. Alternative Wastewater Management Plans for the Freshwater Pond System Watersheds:

1. Freshwater Pond System Watershed Plan 1. This plan included the following components:
   - Sewer extension to the properties in the watershed, the extent of which is displayed in Figure 2.
   - Construction of a new community/municipal wastewater treatment facility at the Roach Property site in Northern Eastham. The property is outlined in red in Figure 2. These

components would be the same as previously discussed in the Rock Harbor Watershed Plan 1 and Nauset-Town Cove Estuary Watershed Plan 1

2. Freshwater Pond System Watershed Plan 2. This plan included the following components:
   - Sewer extension to the properties in the watershed.
   - Connection of this sewer system to the Orleans Wastewater Treatment Facility proposed to be constructed at the Tri-Town Facility site.
3. Freshwater Pond System Watershed Plan 3 **(Recommended as part of the 2009 planning efforts)**. This plan included periodic treatment of the ponds that exceed threshold levels being developed by the Cape Cod Commission.

In addition to the plans summarized above the following Best Management Practices for Town-wide application were recommended as part of all of the plans:

- Fertilizer use education to minimize over-fertilization.
- Stormwater management practices on Town and State roadways as well as at individual homes.

2.2. Town of Orleans CWMP Project

The Town of Orleans CWMP was initially completed in December 2010 with the submission of their Comprehensive Wastewater Management Plan and Single Environmental Impact Report (CWMP/SEIR) by Wright-Pierce. This plan was reviewed under and approved by the Massachusetts Environmental Protection Act (MEPA) review as summarized in the January 28, 2011 MEPA Certificate, and approved by the Cape Cod Commission in their October 31, 2011 Development of Regional Impact (DRI) decision. These three documents are located on the Orleans Town Web site at http://www.town.orleans.ma.us/water-quality-advisory-panel/pages/cwmpwastewater-archives.

The Orleans CWMP/SEIR provides discussion on the opportunity for regionalization of wastewater management with Eastham and Brewster after the first three phases of the Orleans core program[1].

There have been several additional planning efforts to identify additional and/or different wastewater and nutrient management approaches in Orleans as identified on the Town's Web site. The most recent effort was a series of evaluations using the 208 planning methods developed by the Cape Cod Commission. These evaluations and the resulting Town decision-making process resulted in a group of agreed upon goals, objectives, plan approaches, and commitments that are summarized in a March 2015 Consensus Statement (attached in Appendix B of Technical Memorandum No. 1). This document identifies the following next steps:

- Continue evaluations of a group of non-traditional nutrient management technologies which include Coastal Habitat Restoration, Aquaculture, Floating Constructed Wetlands, Permeable Reactive Barriers, and Water Body Inlet Management.

[1] Orleans CWMP/SEIR, Executive Summary page ES-4.

- Continue evaluation of the following two wastewater treatment concepts:
  - Sewer system development for a group of approximately 280 parcels (estimated flow of 100,000 gallons per day) in downtown Orleans with treatment (co-treatment with septage) at a new treatment facility at the Tri-Town facility; treated-water recharge to be at a site remote from the Tri-Town site.
  - Sewer system development for a group of approximately 360 parcels (estimated flow of 50,000 gallons per day) in the Meeting House Pond sub-watershed. Treatment and treated-water recharge to be at one or more sites to be designated.

The Orleans spring Town Meeting appropriated funds for FY2016 to proceed with these evaluations. The evaluations and subsequent pilot studies are expected to require more than one year to complete. As part of this most recent planning effort in Orleans, no reference was made to regionalization outside of continuing to accept septage from communities that are currently served by the existing Tri-Town Septage Treatment Plant.

2.3. Cape Cod Commission 208 Planning

The Cape Cod Commission has finalized their 208 Plan update for Cape Cod (CCC 208 Plan) which brings many new wastewater planning components to a municipal wastewater planning process, such as Eastham's, including:

- Identification of Waste Management Agencies (WMA) that will work to share responsibility to meet the nitrogen TMDLs for coastal estuaries.
- Development of Watershed Reports for each watershed within Town boundaries.
- New wastewater management evaluation tools to estimate existing and future wastewater flows and nitrogen loading as well as alternative wastewater nitrogen management scenarios.
- The requirement to complete a Targeted Watershed Management Plan (TWMP) for estuaries and their watersheds that exceed established nitrogen TMDLs.
- Revised regulatory procedures to streamline the review process once a TWMP is properly completed.
- Recommendations to MassDEP to develop a watershed permitting program to allow nitrogen removal credits for traditional as well as non-traditional management techniques to meet a nitrogen TMDL.
- County support to develop individual TWMPs.

The Plan is awaiting final approval from USEPA in September, however towns are encouraged to use this tool; therefore the next steps of Eastham's wastewater management planning project will utilize many of these components. Towns will be expected to file watershed reports in a format presented by the CCC in June 2015. These reports are anticipated to be submitted to the CCC within one year of that date.

3. ADDITIONAL NITROGEN MANAGEMENT CONCEPTS DEVELOPED IN THE CCC 208 PLAN

The CCC 208 Plan includes a Water Quality Technologies Matrix which outlines technologies and approaches for nutrient management. The plan categorizes 67 nutrient reduction, remediation and restoration technologies and approaches into 10 categories. A description of the technologies considered is also provided in the plan.

Table 1 provides a comparison of the technologies discussed in 2009 ASAR and the CCC 208 Plan, a summary of the 2009 ASAR recommendation on whether the alternative should be retained for further evaluation and an updated recommendation. Updated recommendations will be discussed further in Section 4.

As shown in the table, the majority of 208 approaches were considered as part of previous Eastham evaluations. However, as adaptive management approaches are considered in the future for reducing nutrient loadings to the Town's watersheds, the originally considered technologies—in addition to some of these non-traditional approaches currently being piloted and implemented regionally—can be considered in the future. Legislation changes in Massachusetts have also opened the possibility of ocean outfall as an alternative for treated effluent disposal. However this is still a very involved process that would require extensive siting and studies and permitting to determine its feasibility for use and therefore would only be considered as a last resort and more of the "soft" solution approaches should be considered in earlier phases.

Table 1 Comparison of Technologies Discussed in the 2009 ASAR and the CCC 208 Plan

	Technologies Considered in the 2009 ASAR	Technologies Considered in CCC 208 Plan	2009 ASAR Recommendation	Updated Recommendation
Green Infrastructure	Natural Treatment Systems: • Constructed Wetlands for Nitrogen Attenuation • Hydroponic systems	• Constructed Wetlands – Surface Flow – Subsurface Flow – Groundwater Treatment • Hydroponic Treatment • Phytoirrigation • Phytoremediation	Not included in the Alternative Wastewater Management Plans (WMAs) selected for detailed evaluation.	It is recommended that these approaches be retained as part of an adaptive management program and may be considered for further evaluation and practical opportunities as more data on their viability becomes available through regional piloting and DEP guidance.
	Stormwater Best Management Practices: • Subsurface leaching pits • Vegetated swales or basins • Constructed wetlands	Stormwater Best Management Practices: • Phytobuffer • Vegetated Swale • Gravel Wetland • Bioretention/Soil Media Filters • Constructed Wetlands	Recommended for Town-wide implementation as part of all the WMAS selected for detailed evaluation.	Recommended for Town-wide implementation as part of all the WMAS selected for detailed evaluation.

	Technologies Considered in the 2009 ASAR	Technologies Considered in CCC 208 Plan	2009 ASAR Recommendation	Updated Recommendation
Innovative and Resource Management Technologies	Shellfish Aquaculture/ Propagation was not evaluated in the 2009 efforts	Aquaculture: • Shellfish cultivated in Estuary Bed • Shellfish Cultivated Above Estuary Bed • Mariculture	Not evaluated.	Several Cape Cod communities are piloting aquaculture projects – including Orleans, Mashpee and Falmouth. It is recommended that the results of these pilot and planning projects be reviewed and that this alternative be retained for further evaluation. Discussions with the Town have indicated that there may be opportunities within Salt Pond and Town Cove.
	Nitrate Barrier Wall	Permeable Reactive Barriers (PRBs): • Trench Method • Injection Well Method	Not included in the WMAs selected for detailed evaluation.	The Town of Orleans is planning to implement a PRB pilot. It is recommended that the results of this pilot project be reviewed and that this alternative be retained for further evaluation.
	Fertigation Wells were not evaluated in the 2009 efforts	Fertigation Wells: • Turf • Cranberry Bogs	Not evaluated.	It is recommended that this approach be retained as part of an adaptive management program and may be considered for further evaluation and practical opportunities as more data on their viability becomes available through regional piloting and DEP guidance.
Waste Reduction Toilets	Toilets: • Composting • Incinerating • Waterless • Urine Diverting	Toilets: • Composting • Incinerating • Packaging (waterless) • Urine Diverting	Not included in the WMAs selected for detailed evaluation.	Not recommended for further evaluation for large scale application as homeowner/property owner acceptance of this may be limited. However it is recommended that these systems be retained as part of an adaptive management program and may be considered for further evaluation if practical opportunities present themselves and be available to those property owners willing or interested in converting to these types of systems.
	Tight Tanks	Not identified as part of the 208 Planning efforts.	Not included in the WMAs selected for detailed evaluation.	Recommended for use only where allowed/approved by MassDEP, and only on a temporary basis until a long term solution is found.

	Technologies Considered in the 2009 ASAR	Technologies Considered in CCC 208 Plan	2009 ASAR Recommendation	Updated Recommendation
Non-Structural Approaches	Reduction of Wastewater loadings • Eliminating garbage grinders • Reducing pharmaceutical load in wastewater	Not specifically addressed as part of the current 208 Plan, however, CECs and other potential contaminates are part of the greater effort to protect the Cape's water resources.	Not included in the WMAs selected for detailed evaluation.	It is recommended that all non-structural approaches be included in the recommended plan.
	Fertilizer reduction	Fertilizer Management	Recommended for Town-wide implementation as part of all the WMAS selected for detailed evaluation.	
	Landscape design practices	Not specifically addressed in 208 Plan	Not included in the WMAs selected for detailed evaluation.	
	Animal waste management	Not specifically addressed in 208 Plan	Not included in the WMAs selected for detailed evaluation.	
	Stormwater management and treatment	Stormwater BMPs	Recommended for Town-wide implementation as part of all the WMAS selected for detailed evaluation.	
	Modified Zoning	Nutrient Reducing Development Compact and Open Space Development Transfer of Development Rights	Not included in the WMAs selected for detailed evaluation.	
System Alternatives	Improved tidal flushing	Inlet/Culvert Widening	Not included in the WMAs selected for detailed evaluation.	Further evaluation for improved tidal flushing and/or watershed modification at the Rock Harbor boat basin to lower needed wastewater nitrogen removals from the watershed is recommended.
	Coastal Habitat Restoration was not evaluated in the 2009 efforts	Coastal Habitat Restoration	No evaluated.	The Town of Orleans is planning to implement a coastal; restoration pilot. It is recommended that the results of this pilot project be reviewed and that this alternative be retained for further evaluation.

	Technologies Considered in the 2009 ASAR	Technologies Considered in CCC 208 Plan	2009 ASAR Recommendation	Updated Recommendation
	Floating Constructed Wetlands were not evaluated in the 2009 efforts	Floating Constructed Wetlands	Not evaluated.	The Town of Orleans is planning to implement a floating constructed wetland pilot. It is recommended that the results of this pilot project be reviewed and that this alternative be retained for further evaluation.
	Pond Treatment	Pond and Estuary Circulators	Not included in the WMAs selected for detailed evaluation.	It is recommended that the alternatives recommended in the Town of Eastham's Pond Action Plan, dated December 2011, continue to be implemented. Treatments to Herring Pond and Great Pond were completed. Town has continued with its dredging program for Rock Harbor.
		Surface Water Remediation Wetlands	Not included in the WMAs selected for detailed evaluation.	
		Chemical Treatment of Ponds	Recommended for further evaluation as part of Freshwater Pond System Watershed Plan 2.	
		Pond and Estuary Dredging	Dredging was recommended as part of Rock Harbor Plan 3.	
On-Site Treatment Systems	Title 5 Septic Systems	Title 5 Septic System Replacement (Base Line Condition)	Not evaluated as standard systems remain part of the nutrient problem to pond and estuaries.	Due to the low nitrogen and phosphorus removal rates of Title 5 septic systems this alternative is not recommended for further evaluation in nutrient sensitive areas.
	• JET Aerobic Wastewater Treatment • Orenco Intermittent Filter	• Innovative/Alternative (I/A) Systems • Innovative/Alternative (I/A) Enhanced Systems	Recommended for further evaluation as part of Nauset-Town Cove Estuary Watershed Plan 3.	I/A technologies are only considered for the Nauset-Town Cove Estuary and for the Rock Harbor Estuary for I/As that achieve a total effluent wastewater nitrogen concentration of 5 mg/L or less based on future flows. I/A selection would be up to the discretion of the homeowner to choose the appropriate MassDEP approved technology.
	• Recirculating Sand Filters (Non-Proprietary Filters • RUCK® System • Bioclere • Micro-, High Strength-, Nitri- and Modular-FAST • Waterloo Biofilter • Advantex® • NITREXTM System • SeptiTech System			

	Technologies Considered in the 2009 ASAR	Technologies Considered in CCC 208 Plan	2009 ASAR Recommendation	Updated Recommendation
	• Norweco Singulair • Cromaglass System • Omni Recirculating Sand Filter • Bio Barrier MBR WWT System • NITREXTM Plus			
Treatment Systems	• Rotating Biological Contactors • Sequencing Batch Reactors • Amphidrome • Membrane Bioreactor • MicroFAST, High Strength FAST, NitriFAST and Modular FAST Systems • Bioclere	• Cluster Treatment System – Single Stage • Cluster Treatment System – Two Stage	Not recommended as part of 2009 evaluations.	Recommended to be retained for further consideration in areas that do not need treatment to 3 mg/L, the highest degree of performance
	• Activated Sludge with Modified Ludzack-Ettinger (MLE) Process • Rotating Biological Contactors • Sequencing Batch Reactors • Membrane Bio-Reactor • Oxidation Ditches • Aerated Biological Filters • Denitrification Filters • Technologies Used to Achieve Less than 3 mg/L Total Nitrogen • Adsorption • Advanced Oxidation Technologies	• Conventional Treatment • Advanced Treatment	Recommended for further evaluation as part of Rock Harbor Watershed Plan 1, Nauset-Town Cove Estuary Plan 1 and Freshwater Pond System Watershed Plan 1.	Due to the high costs, complex controls and need of supplemental processes, Aerated Biological Filters are not considered for further evaluation. The remaining secondary/advanced treatment technologies screened for larger (community/municipal) WWTFs are recommended to be retained for further consideration.

	Technologies Considered in the 2009 ASAR	Technologies Considered in CCC 208 Plan	2009 ASAR Recommendation	Updated Recommendation
	• Precipitation • Ion Exchange • Breakpoint Chlorination • Membrane Filtration • Technologies to Remove Endocrine Disrupters • Phosphorus Technologies			
	• Disinfection Technologies • Ozone • Ultraviolet Radiation		UV disinfection recommended for further evaluation as part of Rock Harbor Watershed Plan 1, Nauset-Town Cove Estuary Plan 1 and Freshwater Pond System Watershed Plan 1.	UV recommended for use based on previous evaluations regarding disinfection.
	• Rotating Biological Contactors • Sequencing Batch Reactors • Amphidrome • Membrane Bioreactor • MicroFAST, High Strength FAST, NitriFAST and Modular FAST Systems • Bioclere	• Satellite Treatment • Satellite Treatment - Enhanced	Recommended for further evaluation as part of Rock Harbor Watershed Plan 1, Nauset-Town Cove Estuary Plan 1 and Freshwater Pond System Watershed Plan 1.	Recommended to be retained for further consideration in areas that do not need treatment to 3 mg/L, the highest degree of performance.
Collection Systems	Gravity Sewer	Gravity Sewer	Recommended for further evaluation as part of Rock Harbor Watershed Plans 1 & 2, Nauset-Town Cove Estuary Watershed Plans 1 & 2 and Freshwater Pond System Watershed lp.	Recommended that all collection technologies be retained for further consideration/
	Pressure sewers with grinder pumps	Low Pressure Sewer	Recommended for further evaluation as part of Rock Harbor	

	Technologies Considered in the 2009 ASAR	Technologies Considered in CCC 208 Plan	2009 ASAR Recommendation	Updated Recommendation
			Watershed Plans 1 & 2 and Nauset-Town Cove Estuary Watershed Plans 1 & 2.	
	Vacuum Sewer	Vacuum Sewer	Recommended for further evaluation as part of Rock Harbor Watershed Plans 1 & 2 and Nauset-Town Cove Estuary Watershed Plans 1 & 2.	
	Force Main	Force Main	Recommended for further evaluation as part of Rock Harbor Watershed Plans 1 & 2 and Nauset-Town Cove Estuary Watershed Plans 1 & 2.	
	Pump Station	Pump Station	Recommended for further evaluation as part of Rock Harbor Watershed Plans 1 & 2 and Nauset-Town Cove Estuary Watershed Plans 1 & 2.	
		On-Site Pump Station	Recommended for further evaluation as part of Rock Harbor Watershed Plans 1 & 2 and Nauset-Town Cove Estuary Watershed Plans 1 & 2.	
	Septic Tank Effluent Gravity (STEG) System	STEG- Collection	Recommended for further evaluation as part of Rock Harbor Watershed Plans 1 & 2 and Nauset-Town Cove Estuary Watershed Plans 1 & 2.	
	Septic Tank Effluent Pump (STEP) System	STEP - Collection	Recommended for further evaluation as part of Rock Harbor Watershed Plans 1 and Nauset-Town Cove Estuary Watershed Plans 1.	

	Technologies Considered in the 2009 ASAR	Technologies Considered in CCC 208 Plan	2009 ASAR Recommendation	Updated Recommendation
Effluent Disposal	Sand Infiltration Beds	Effluent Disposal – Infiltration Basins	Recommended for further evaluation as part of Rock Harbor Watershed Plans 1 and Nauset-Town Cove Estuary Watershed Plans 1.	With the exception of ocean outfalls it is recommended that all treated water recharge technologies be retained for further evaluation. Ocean outfalls may be considered based on the shift in regulations, and may be considered as a final resort if effluent recharge facility sites are unavailable.
	Subsurface Infiltration	Effluent Disposal – Soil Absorption System (SAS)	Recommended for further evaluation as part of Rock Harbor Watershed Plans 1 and Nauset-Town Cove Estuary Watershed Plans 1.	
	Spray Irrigation		Recommended for further evaluation as part of Rock Harbor Watershed Plans 1 and Nauset-Town Cove Estuary Watershed Plans 1.	
	Drip Irrigation		Recommended for further evaluation as part of Rock Harbor Watershed Plans 1 and Nauset-Town Cove Estuary Watershed Plans 1.	
	Well Injection	Effluent Disposal – Injection Well	Recommended for further evaluation as part of Rock Harbor Watershed Plans 1 and Nauset-Town Cove Estuary Watershed Plans 1.	
	Wick Well Technology	Effluent Disposal – Wick Well	Recommended for further evaluation as part of Rock Harbor Watershed Plans 1 and Nauset-Town Cove Estuary Watershed Plans 1.	
	Wetland Restoration		Recommended for further evaluation as part of Rock Harbor	

	Technologies Considered in the 2009 ASAR	Technologies Considered in CCC 208 Plan	2009 ASAR Recommendation	Updated Recommendation
			Watershed Plans 1 and Nauset-Town Cove Estuary Watershed Plans 1.	
	Ocean Outfall	Effluent Disposal – Ocean Outfall	Not evaluated.	
	Regional recharge facilities	Effluent Transport out of Watershed to Recharge, Reuse Facility or Ocean Outfall	Recommended as part of a regional solution with Orleans in 2009	
Solids Processing	Septage Processing	Septage Processing	Recommended for further evaluation as part of Rock Harbor Watershed Plans 1 & 2 and Nauset-Town Cove Estuary Watershed Plans 1 & 2.	Disposal at the Tri-Town Septage Treatment Facility in Orleans recommended for continued use.
	• Sludge Thickening and Disposal at a Regional Facility • Sludge Dewatering and Disposal at a Regional Facility	Commercial Disposal • Dewater and Haul to Landfill • Incineration	Commercial disposal of thickened sludge recommended for further evaluation as part of Rock Harbor Watershed Plans 1 & 2 and Nauset-Town Cove Estuary Watershed Plans 1 & 2.	Disposal of thickened sludge believed to be the most practical sludge disposal alternative and is recommended.
	Sludge Dewatering, Composing and Distribution to the Public	Composting	Not included in the WMAs selected for detailed evaluation.	Land area for building requirements will be either site restrictive or cost prohibitive therefore it is not recommended for further evaluation.
	Alkaline Stabilization	Lime Stabilization	Not included in the WMAs selected for detailed evaluation.	Alkaline stabilization typically not cost effective for small sludge flows in areas where there is not a market for the final product. Due to the lack of an agricultural market on Cape Cod this alternative is not recommended for further evaluation.
	Digestion	Digestion	Not included in the WMAs selected for detailed evaluation.	Not cost effective for small flows – not recommended for further evaluation.
	Heat Treatment and Drying	Thermal Drying	Not included in the WMAs selected for	Process generally has high capital costs, high level of complexity, high

	Technologies Considered in the 2009 ASAR	Technologies Considered in CCC 208 Plan	2009 ASAR Recommendation	Updated Recommendation
			detailed evaluation.	energy usage and operations and is usually poorly received by the public due to air emissions. Usually not cost effective for small flows. Not recommended for further evaluation.
		Drying and Gasification	Not included in the WMAs selected for detailed evaluation.	Process generally has high capital costs, high level of complexity and high energy usage. Not recommended for further evaluation.

4. RECONSIDERATION OF ALTERNATIVES SCREENED IN MARCH 2009 FINAL INTERIM (NEEDS ASSESSMENT) & ALTERNATIVES SCREENING ANALYSIS REPORT

It is recommended that as a result of the potential shift in regional options with Orleans on traditional infrastructure that components of these 2009 alternative wastewater management "plans" be reevaluated as part of the "Hybrid" alternative solutions development discussed at the end of this document. With regards to Rock Harbor Watershed Plan 2 and Nauset-Town Cove Watershed Plan 2 (which were the recommended plans identified in 2009 Plan evaluation report), it is recognized that the 'Orleans Water Quality Advisory Panel Consensus Agreement of the OWQAP March 11, 2015' states that the Town of Orleans is currently proposing to design a new treatment plant capable of treating septage from the towns currently served by the Tri-Town Septage Treatment Plant and wastewater only from downtown Orleans. Even though the facility is currently proposed to only treat wastewater from Orleans, the Town of Eastham continues to be interested in pursuing an inter-municipal agreement to connect to the Orleans Wastewater Treatment Facility if capacity were available. It is recommended that further discussion on this regional approach and other non-traditional regional approaches continue with the Town of Orleans.

In addition to the alternatives developed in the 2009 ASAR it also recommended that non-traditional nutrient mitigation technologies be considered for further evaluation as part of the hybrid approaches to address nitrogen loading to Salt Pond and Town Cove. These technologies include:

- Natural treatment systems
- Shellfish aquaculture/propagation
- Permeable reactive barriers (PRB)
- Fertigation wells
- Non-structural approaches
- Improved tidal flushing
- Coastal habitat restoration

- Floating constructed wetlands

While generally regarded as experimental technologies and not as well defined in terms of predictable performance as a more conventional system, the technologies listed above are being proposed as pilot studies in the neighboring Town of Orleans and other Cape Cod communities. If a suitable application is identified for these technologies in the Town of Eastham, it is recommended that pilot data be analyzed to determine whether the technology should be retained for further evaluation.

The Town submitted to the USEPA the Salt Pond Visitor Center site as a possible location for PRB site characterization as part of a grant opportunity through USEPA. Although the funding source could not be applied to this location, it remains a potentially viable pilot opportunity and will be actively included as part of the hybrid evaluations for Salt Pond.

In addition, the Town has had preliminary discussions with former and existing staff familiar with shellfish opportunities within the Town (specifically Town Cove and Salt Pond). The Town currently has existing open shellfish beds and shellfish grant holders within the Town Cove watershed. Because of the high salinity levels, it is likely that these would support chowder quahogs (similar to approaches in Mashpee to use quahogs versus oysters being used in other parts of Mashpee, Falmouth, and Wellfleet). The existing estuary bottom could support these efforts. There are also opportunities in the Town Cove Flats for regional solutions with Orleans; and Orleans has identified shellfish as an approach they are going to further evaluate.

Oyster reefs are unlikely based on the high possibility of predation. Further discussion is recommended with the Town's Natural Resource Officer and Department of Public Works regarding these approaches as part of a hybrid solution.

The Town has also recently performed dredging within the Rock Harbor basin as part of long-term management of that waterbody. The Town should consider additional data evaluation within this waterbody to see if any measurable improvement might be obtained as discussed previously.

5. BACKGROUND (BOOKEND) EVALUATIONS DEVELOPED IN 208 PLANNING PROJECT

Bookend evaluations have been developed by CCC for Nauset Harbor, Town Cove, and Salt Pond. A bookend evaluation compares the two spectrums of a nutrient management solution—one comprised completely of traditional infrastructure and one entirely made up of non-traditional technologies. The CCC developed these bookends so that communities can use this data to develop a hybrid solution that utilizes both traditional and non-traditional mitigation measures.

The bookend evaluations are conducted using the CCC Tracker model. Nitrogen removal targets for each sub-watershed in Tracker are based on the targets listed in the Massachusetts Estuary Project (MEP). This approach is slightly different than the GIS based approach that has been typically used by most communities to determine buildout potential and resulting future wastewater flows and nutrient loadings.

The Tracker model uses nutrient removal assumptions for a defined set of technologies to model how the potential effectiveness of a technology (or combination of technologies) may be in the area of interest. The CCC Tracker model uses regional water use averages for the development of water flow data in the Town of

Eastham, since the Town does not currently have a Town-wide public water system. The buildout potential for a region is based on a Massachusetts-wide zoning layer compiled for the Commonwealth of Massachusetts Executive Office of Environmental Affairs (EOEA) buildout, which was prepared in 2014. The following technologies are considered traditional infrastructure technologies in Tracker:

- Fertilizer Reduction
- Stormwater Reduction
- Gray Infrastructure (wastewater collection, treatment, and recharge)

The following technologies are considered non-traditional solutions:

- Permeable Reactive Barriers
- Constructed Wetlands (No Collection)
- Constructed Wetlands (With Collection)
- Coastal Habitat Restoration
- Phytobuffers
- Fertigation (turf)
- Fertigation (bogs)
- Floating constructed wetlands
- Surface water remediation wetland
- Phytoremediation
- Aquaculture
- Eco-toilets
- Urine-diversion (UD)
- I/A Systems
- Enhanced I/A Systems
- Enhanced Attenuation

CCC has developed several non-traditional bookend solutions for Nauset Harbor (which includes Town Cove and Salt Pond) and Rock Harbor, based on the vast number of choices one could make in using non-traditional solutions. However these evaluations are based on the entire watershed and include impacts from both Eastham and Orleans as they relate to the Nauset System and Rock Harbor.

Two non-traditional bookend alternatives developed by CCC for Nauset Harbor are outlined in Table 2. The Tracker model calculates the quantities (linear feet, areas, number of properties served, number of systems, etc.) of different technologies needed to meet a nutrient mitigation goal. The quantities can be input to the 208 Map Viewer (which was also developed by CCC) to determine proposed locations for the technologies. An example of the 208 Map Viewer output for Nauset Harbor is shown in Figure 3. Further studies would be

needed to determine the optimal locations for these technologies based on variables that are not included in the 208 Map Viewer, such as site suitability and public acceptance.

Table 2 Nauset Harbor Bookend Evaluation Alternatives

Technology	Quantity	
	Bookend Example #1	Bookend Example #2
Fertilizer Management	50% removal	25% removal
Stormwater Mitigation	50% removal	25% removal
Permeable Reactive Barrier	16,675 linear feet	16,675 linear feet
Fertigation - turf	10 acres	--
Floating Constructed Wetlands	2,500 cubic feet	--
Ecotoilets (UD and compost)	27 homes	--
UD School or Public Facility	402 people	--
I&A Systems	60 homes	--
Enhanced I&A Systems	3 homes	--
Unattenuated Load Remainder	109 homes	1,661 homes

Two non-traditional bookend alternatives developed by CCC for Rock Harbor are outlined in Table 3.

Table 3 Rock Harbor Bookend Evaluation Alternatives

Technology	Quantity	
	Example Bookend #1	Example Bookend #2
Fertilizer management	25% removal	25% removal
Stormwater mitigation	25% removal	25% removal
Permeable reactive barriers	1,500 linear feet	1,500 linear feet
Coastal habitat restoration	--	2 acres
Floating constructed wetlands	--	750 cubic feet
Ecotoilets (UD and compost)	--	17 homes
I&A systems	--	24 homes
Unattenuated load remainder	341 homes	--

The bookends are simply guides established to provide starting points for communities as they approach the development of hybrid solutions (combination of traditional and non-traditional approaches). These will be used as a reference point for the hybrid evaluations are performed for Salt Pond and Town Cove as called for in the Scope for Task Order #1.

This same Tracker model program will be used to develop hybrid alternatives (alternatives consisting of both traditional and non-traditional mitigation measures) in subsequent phases of this project for both Town Cove and Salt Pond watersheds.

6. SUMMARY OF PREVIOUS ALTERNATIVES AND PROPOSED HYBRID EVALUATION PROCESS FOR THE PROJECT FOCUS AREA

Table 4 summarizes the alternative management plans recommended in the 2009 Plan Evaluation Report.

Table 4 Summary of Recommended Alternative Management Plans

Area of Concern	Alternative Management Plan	Drinking Water Supply (1)	Roach Property WWTF (2)	Orleans WWTF (3)	I/a Systems (4)	Dredging /Aeration (5)	Pond Treatment (6)
Town-Wide (TW)	***TW Drinking Water Supply Plan***	*X*					
Nauset-Town Cove Estuary (NE)	NE Watershed Plan 1		X				
	NE Watershed Plan 2			*X*			
	NE Watershed Plan 3				X		
Rock Harbor Estuary (RH)	NE Watershed Plan 1		X				
	RH Watershed Plan 2			*X*			
	RH Watershed Plan 3					*X*	
Freshwater Pond System (FP)	FP Watershed Plan 1		X				
	FP Watershed Plan 2			X			
	FP Watershed Plan 3						*X*

Notes:

(1) Town to establish public water supply from a protected source; either from new wells within Eastham or from Orleans.

(2) Sewering properties in the watershed (area of concern) and wastewater treatment and recharge at a new community/municipal wastewater treatment facility at the proposed Roach Property WWTF in northern Eastham.

(3) Sewering properties in the watershed (area of concern) and wastewater treatment and recharge at the Orleans WWTF - proposed to be constructed at the Tri-Town Septage Treatment Facility site.

(4) Individual on-site systems approved by MassDEP for nitrogen removal.

(5) Further evaluation of possible aeration and dredging management of Rock Harbor.

(6) Periodic pond treatments with alum.

In the next phase of this project, hybrid evaluations will be developed for Salt Pond and the Eastham side of Town Cove in order to determine the feasibility and cost-effectiveness of incorporating the non-traditional mitigation measures identified in this memorandum into the recommended alternative management plans. A

hybrid evaluation will be performed for each area, and will evaluate each of these sub-watershed systems using the CCC tools and estimate cost and feasibility of the hybrid approach.

The Town has expressed interest in incorporating the following non-traditional technologies into the hybrid evaluations:

- Permeable Reactive Barrier downstream of the Town's landfill.
- Shellfish aquaculture/propagation.
- Improvements to the Salt Pond Visitor Center (Cape Cod National Seashore) onsite wastewater treatment system.
- Stormwater reductions from Route 6/MassDOT.
- Fertilizer reductions.

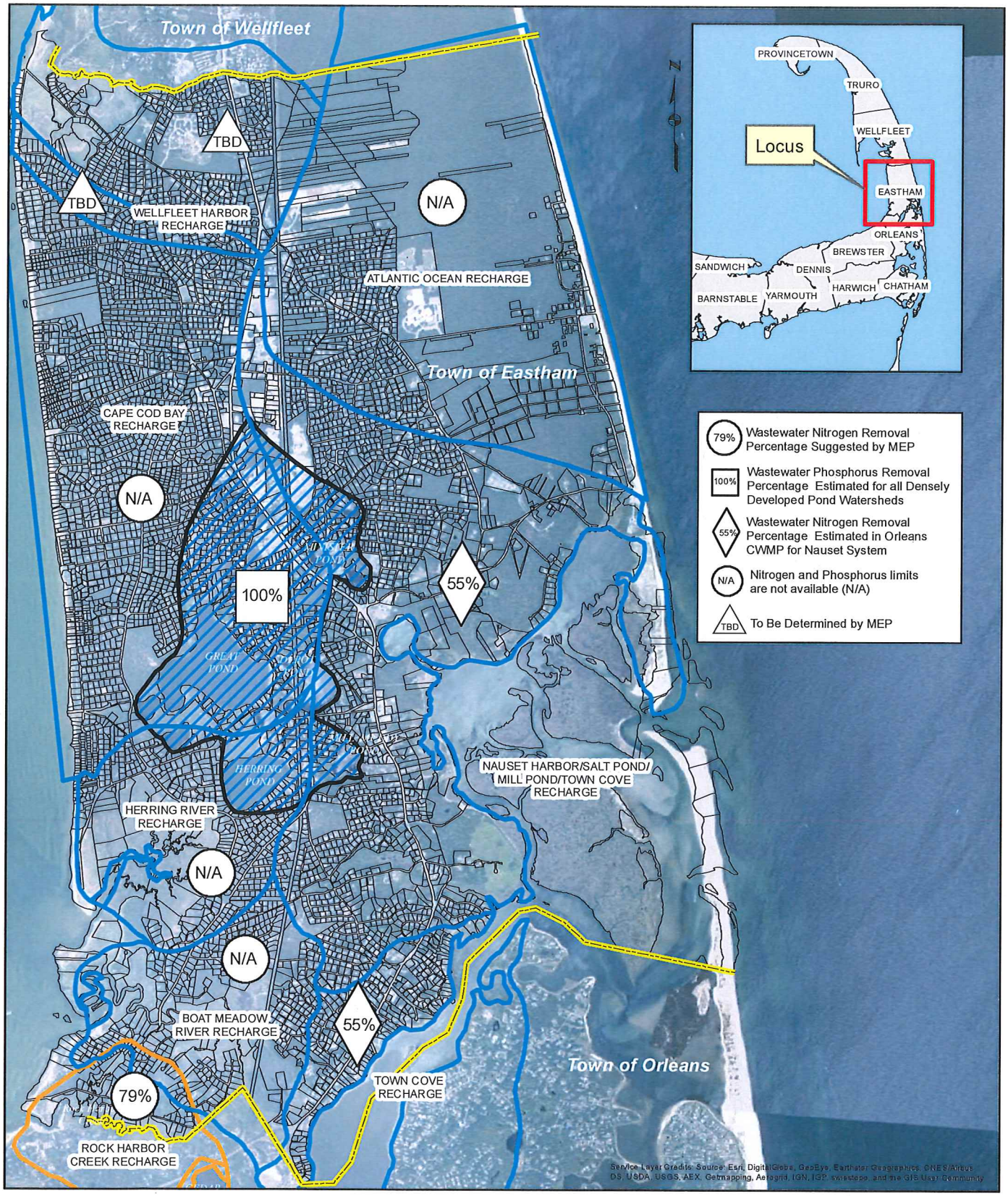
During the development of the hybrid evaluations the other non-traditional technologies identified in this memorandum will be kept in a "toolbox" and incorporated as needed if a feasible solution cannot be reached with the technologies the Town has expressed the most interest in pursuing.

The hybrid evaluations will be conducted using the following approach:

- Develop scenarios which incorporate components of the recommended alternative management plans and the non-traditional technologies the Town is interested in pursuing, through discussions with Town Staff.
- Use the CCC Tracker model and MVP tools to determine the quantity and combination of different technologies that can be used in order meet the nutrient reduction goals.
- Develop cost estimates for each scenario run under the hybrid evaluations.
- Determine potential sites for non-traditional site implementation for each scenario.

The results of the hybrid evaluations will be summarized in Technical Memoranda Nos. 3 and No. 4.

Figures



Legend

Town Line | Cape Cod Commission Watersheds | MEP Watershed | Parcel Boundary

Paper Size ANSI A

0 900 1,800 3,600 Feet

Map Projection: Lambert Conformal Conic
Horizontal Datum: North American 1983
Grid: NAD 1983 StatePlane Massachusetts Mainland FIPS 2001

Town of Eastham, Massachusetts
Technical Memorandum # 2

WATERSHED DELINEATIONS AND ESTIMATED % NUTRIENT REMOVAL

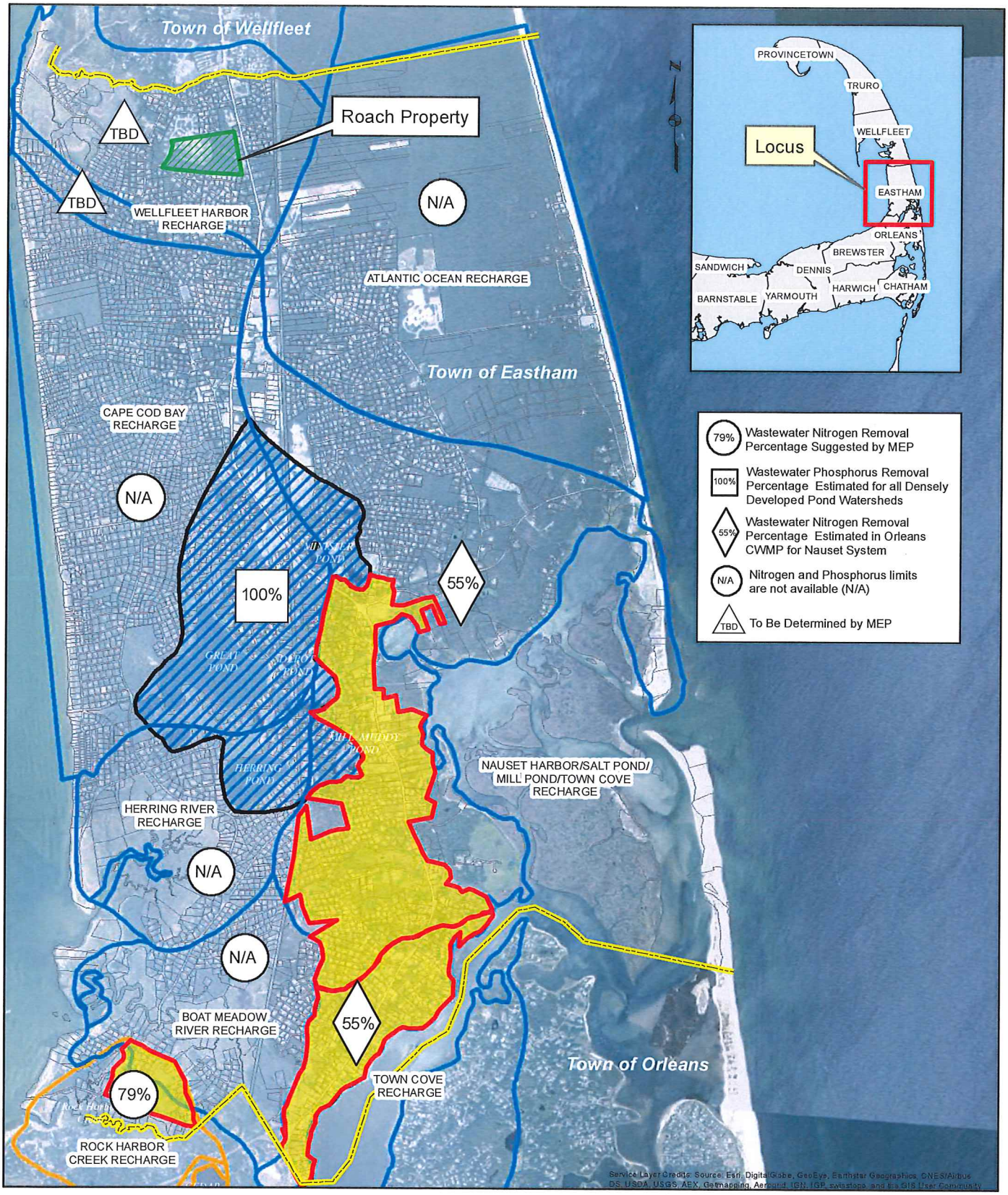
Job Number 86-18665
Revision A
Date 03 Sep 2015

Figure 1

180 Lonsdale Street Melbourne VIC 3000 Australia T 61 3 8687 8000 F 61 3 8687 8111 E melmail@ghd.com W www.ghd.com

N:\US\Hyannis\Projects\86\18665\GIS\Maps\MXD_Deliverables\7-14-2015 Presentation\FIGURES 9-3-2015\Tech Memo 2\86-18665F01.mxd

Data source: Data Custodian, Data Set Name/Title, Version/Date. Created by:jjobrien



Legend

- Tentative Sewer Service Area (Based on Future Flow)
- Cape Cod Commission Watersheds
- MEP Watershed
- Parcel Boundary

Paper Size ANSI A

0 900 1,800 3,600 Feet

Map Projection: Lambert Conformal Conic
Horizontal Datum: North American 1983
Grid: NAD 1983 StatePlane Massachusetts Mainland FIPS 2001

N

GHD

Town of Eastham, Massachusetts
Technical Memorandum # 2

TENTATIVE SEWER SERVICE AREAS

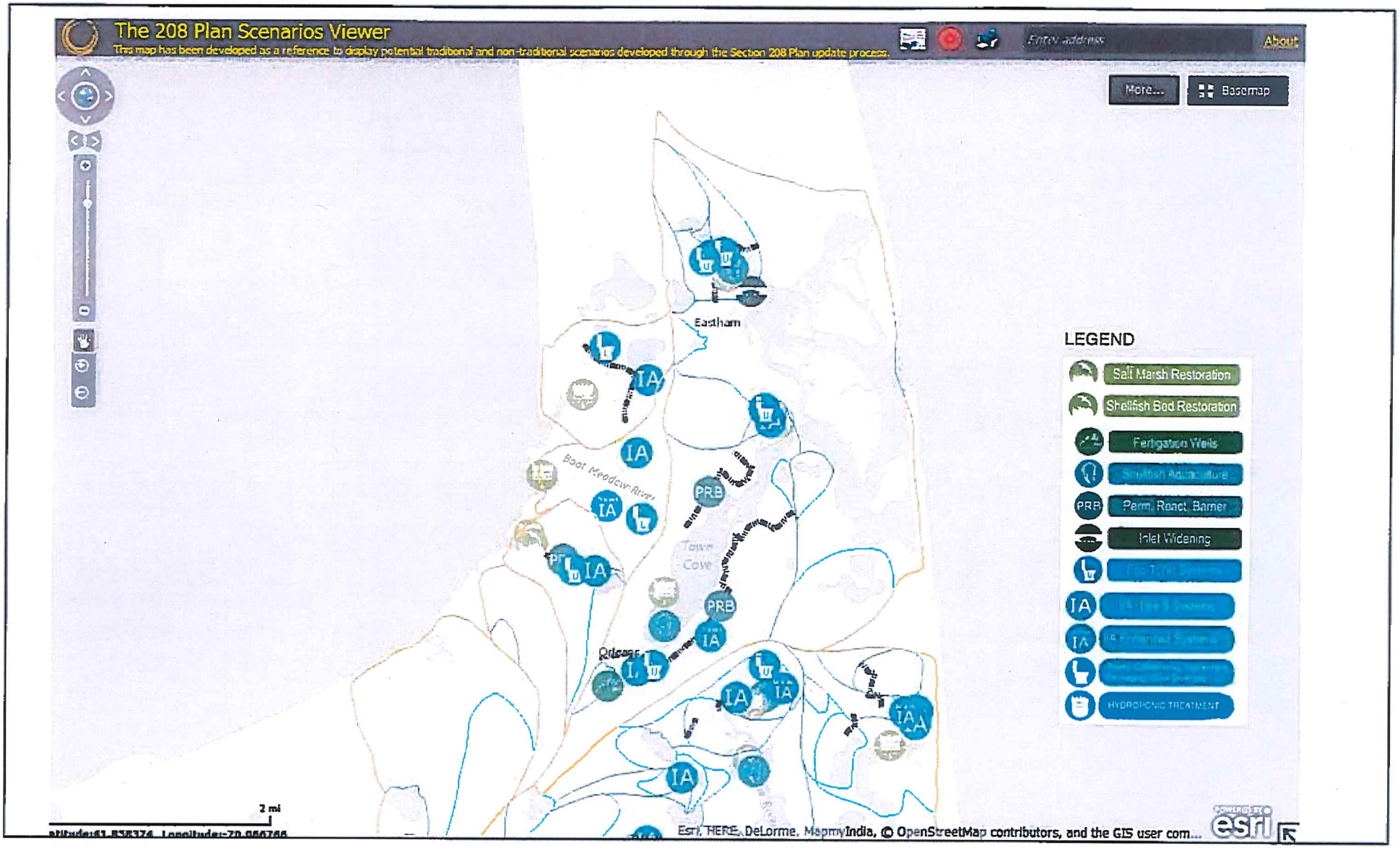
Job Number	86-18665
Revision	A
Date	03 Sep 2015

Figure 2

180 Lonsdale Street Melbourne VIC 3000 Australia T 61 3 8687 8000 F 61 3 8687 8111 E melmail@ghd.com W www.ghd.com

N:\US\Hyannis\Projects\86\18665\GIS\Maps\MXD_Deliverables\7-14-2015 Presentation\FIGURES 9-3-2015\Tech Memo 2\86-18665F02.mxd

Data source: Data Custodian, Data Set Name/Title, Version/Date. Created by:jjobrien



Paper Size ANSI A

N

GHD

Town of Eastham, Massachusetts
Technical Memorandum # 2

Job Number | 86-18665
Revision | A
Date | 03 Sep 2015

208 Plan Scenarios View – Nauset Harbor
Proposed Non-Traditional Technology Locations

Figure 3

N:\US\Hyannis\Projects\86\18665\GIS\Maps\MXD_Deliverables\7-14-2015 Presentation\FIGURES 9-3-2015\Tech Memo 2\86-18665F03.mxd

Data source: Data Custodian, Data Set Name/Title, Version/Date. Created by:ljobrien

180 Lonsdale Street Melbourne VIC 3000 Australia T 61 3 8687 8000 F 61 3 8687 8111 E melmail@ghd.com W www.ghd.com